June 25, 1963 N. A. MacLEOD 3,094,983

BLOOD CIRCULATION DEVICE AND METHOD

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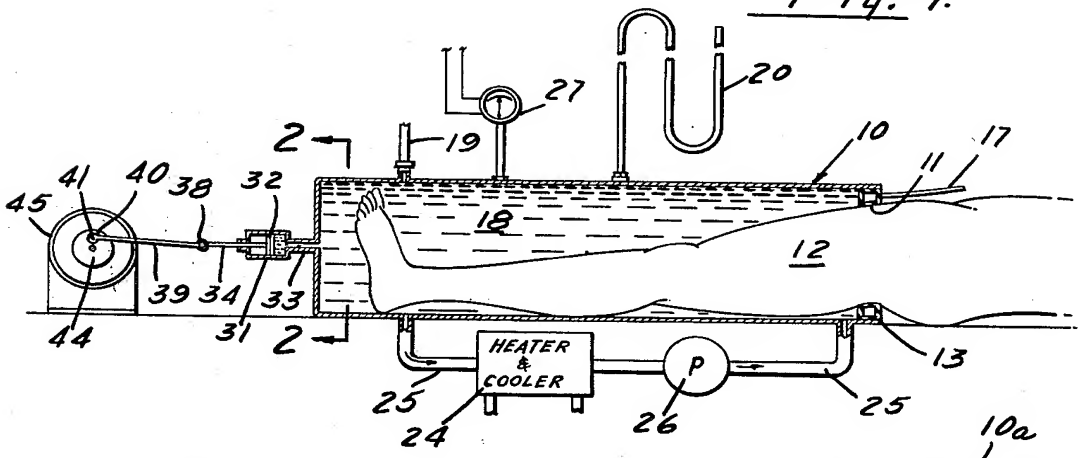
Fig. 1.



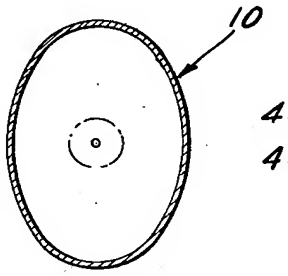


Fig. 2.

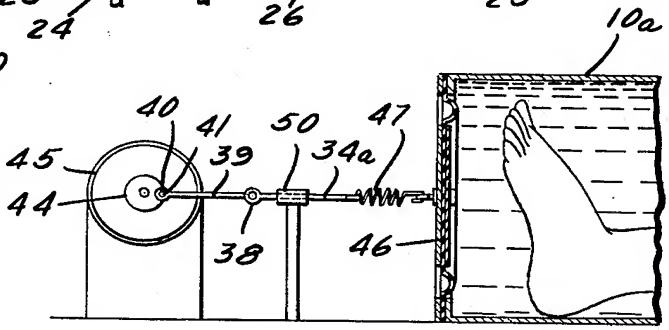


Fig. 3.

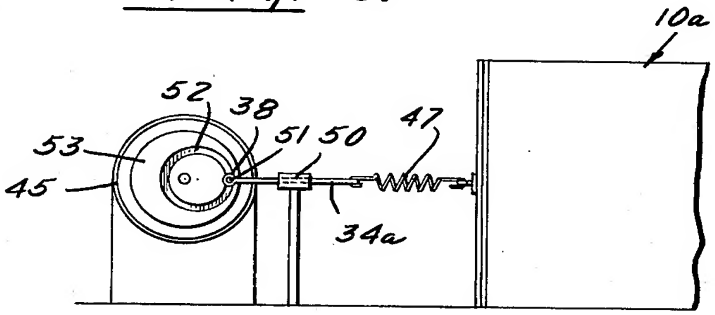


Fig. 4.

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BLOOD CIRCULATION DEVICE AND METHOD

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Fig. 5.

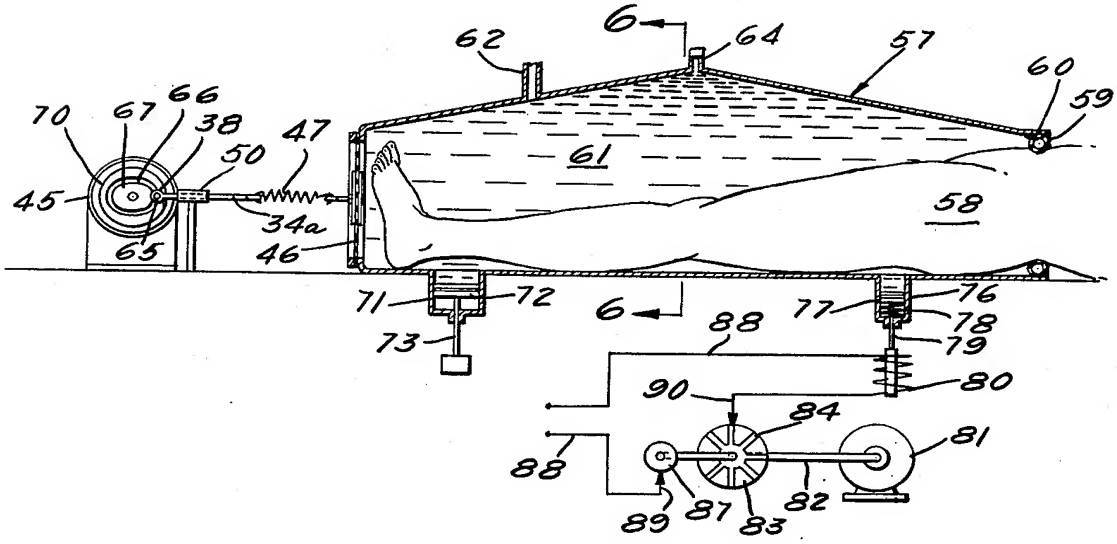


Fig. 6.

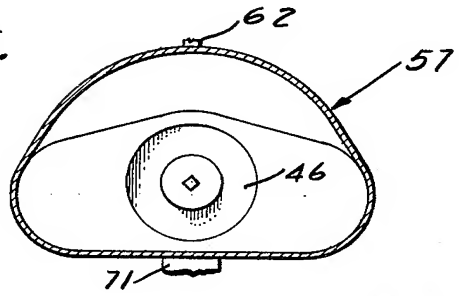


Fig. 7.

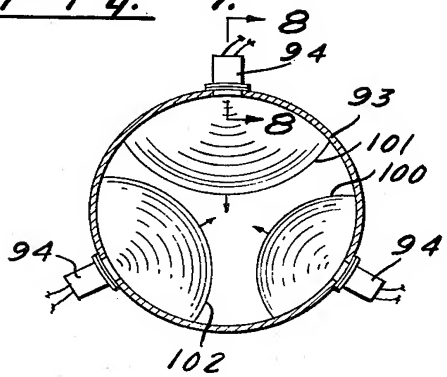
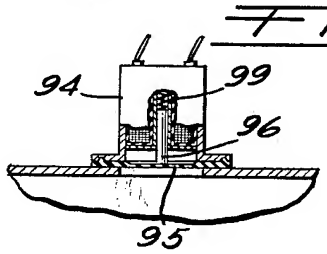


Fig. 8.



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BLOOD CIRCULATION DEVICE AND METHOD

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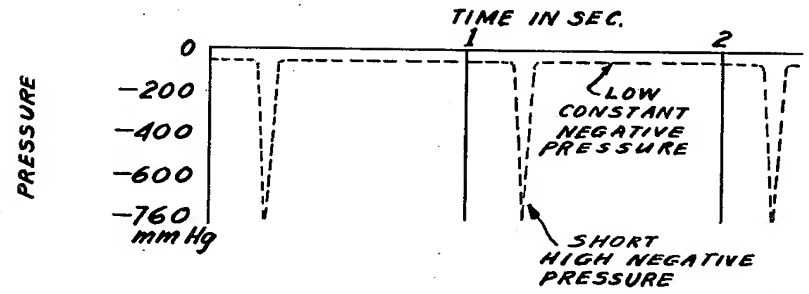

Fig. 9.

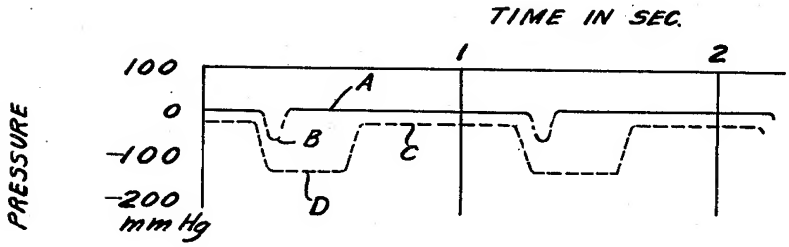

Fig. 10.

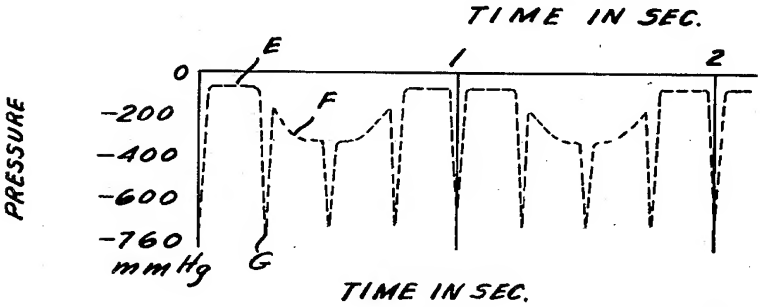

Fig. 11.

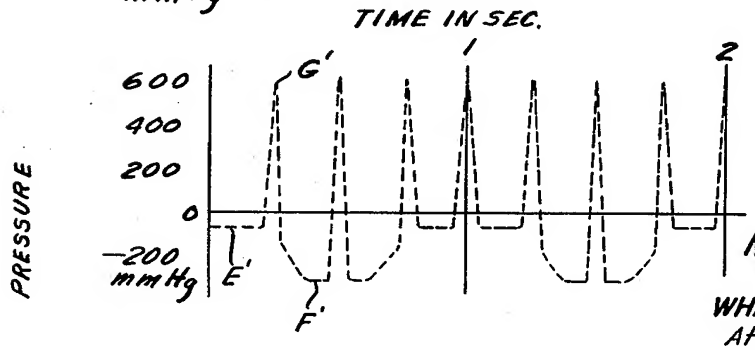

Fig. 12.

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United States Patent Office 3,094,983 Patented June 25, 1963

3,094,983

BLOOD CIRCULATION DEVICE AND METHOD

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Filed July 25, 1961, Ser. No. 126,586
23 Claims. (Cl. 128—40)

This invention relates generally to a method and apparatus for producing rapid and rhythmic pressure variations within parts of the human body or of animals for the purpose of affecting the metabolism of the parts so treated. Treatment according to the invention provides beneficial and corrective results in the muscular, vascular, nervous, lymphatic and skeletal systems.

In the prior art, it has been attempted to produce pressure variation, particularly in the limbs, by varying the pressure of a gas within a closed chamber. Since such a pressure variation involves the addition or removal of the gas, usually air, the rate of rise or fall of pressure within the chamber has been relatively slow and the consequent pressure variation in the body part has been as slow or slower. For example, to reduce the pressure by one half requires the removal of one half of the gas volume. In addition, the variation of pressure in the gas surrounding the limb has produced corresponding and unavoidable variations in temperature, and these variations are generally undesirable during a particular treatment.

Further, according to the present invention, it has been found desirable that the cycle of pressure variation in the chamber should be similar or related to that of the heart. However, in the prior art, where gas has been used, the rate of cyclic operation has been usually 15 to 50 seconds or more per cycle whereas the heart beat produces internal fluctuations of pressure in the order of one beat per second.

It is also known that while blood will flow comparatively unrestrictedly away from the heart through the main arteries, it is prevented from moving away from the heart through the main veins by a system of check valves. Hence, any reduction in pressure in the distant parts of the human body will tend to increase the flow of blood through the arteries, but will have slight effect upon the veins because of the check valves. Indeed, the presence of these check valves in the veins will cause all externally produced pressure fluctuations on the venous side to be translated into increased rate of flow towards the heart. Further, if pressure reduction in the distant parts of the body is pulsed at a rate corresponding to the delivery of blood to the arteries from the heart, according to the invention, it will help such blood flow significantly.

In adult human beings, for example, variations in pressure in the body, and particularly diminished pressure in the extremities, produce a definite improvement in arterial circulation. This effect has been known for almost 150 years and many attempts have been made to enhance this general improvement. However, all of these have used relatively long cycles of rhythmic pressure variation in the obviously convenient use of a gas, such as air, as the surrounding medium. None have used a complete, substantially gas-free liquid medium or have contemplated very fast fluctuations of the pressure of the order of the heart beat rate or greater, nor have they contemplaed very sudden changes in pressure to an extreme where actual cavitation could occur. In the practice of this invention, very sudden pressure changes sufficient to induce pressure waves in the liquid medium and in the body are used. Further, extremes of pressure drop are proposed to induce momentary and microscopic cavitation, or bubble formation, in the blood, with almost

immediate readsorption, the dwell of this low pressure being relatively short. Such cavitation is favored by the sudden lowering of pressure but in the absence of hydrophobic surfaces, which are generally not present in the human body, gas bubbles will rapidly disappear.

The general effect of my invention is to produce at will intense and rapid pressure vibrations of such controllability in time and point of origin as to create focusing effects, and also of such a generally efficient nature as to stimulate, not only the circulation of the blood, but also the metabolism of the individual organs and cellular tissue.

It will be appreciated that such rapid vibrations will affect the character of tissue and particularly of membranes and cell walls in such a way as to increase the rate of osmosis and other liquid phenomena associated with metabolic processes.

It is an object of the present invention to provide an improved method and apparatus for improving the metabolism of parts of human bodies or animals to produce beneficial and corrective results in the muscular, vascular, nervous, lymphatic and skeletal systems.

It is another object of the invention to provide pressure changes within a body at a rate as great or greater than that resulting from the operation of the normal heart and to provide these changes in pressure in cycles as rapid as those of the average heart beat in normal operation and even in fibrillation.

It is a further object of this invention to produce pressure drops in portions of the body being treated, synchronized with the arrival of the pressure pulse from the heart beat in the arteries in said portions of the body.

It is another object of this invention to impose a cyclic pressure variation corresponding to the normal heart beat when the heart is in fibrillation and so induce the heart to return to normal rhythmical action.

It is still another object of the invention to provide within a body not only a rate of pressure rise or fall greater than accomplished by pneumatic methods, but also to provide very great pressure differences for very short periods of time.

It is a further object of the invention to provide rapidly changing pressures so as to create positive (high pressure) and negative (rarefaction) pressure waves which can be made to travel through the various parts of the body under treatment.

It is a still further object of the invention to provide within a body being treated, small amplitude shock waves, using positive and negative pressure variations alone or in alternating sequence of positive and negative waves.

It is another object of the invention to create a series of pressure waves at various points in a pressure chamber and at controlled intervals so that a focusing action can be obtained at a depth within a body being treated to profoundly affect a particular zone under treatment.

It is still another object of the invention to maintain a pressure on a part of the body being treated at a constant level, other than atmospheric, and to induce rhythmic pulsations in pressures above or below, or above and below the constant pressure.

It is a further object of the invention to provide in a treating chamber relatively slow rhythmic change in pressure and to superimpose upon the latter sharp, staccato fluctuations in pressure.

It is a still further object of the invention to provide in a liquid pressure chamber vibratory pulsations at rates between 100 and more than 20,000 vibrations per second.

It is another object of the invention to maintain the portion of the body being treated in a liquid pressure chamber under a constant temperature.

It is still another object of the invention to stimulate metabolic processes in the portion of the body being

treated by increasing molecular movement of tissues therein in a predetermined manner.

It is a further object of the invention to provide a treatment chamber having curved inner surfaces which can be used to generate pressure waves at a multiplicity of points so that a deep-seated focus of wave energy will result.

It is a further object of the invention to provide a cycle through a multiplicity of generative pressure pulse points of origin by progressive stimulation of waves at very short (microsecond) intervals so as to cause an aforesaid deep-seated focus to move in any desired manner.

Another object of the invention is to provide an apparatus and method for stimulating and assisting general blood circulation in a manner so as to relieve the heart muscles of their work load. This is especially important in cases of severe illness, when normally the desired increase in circulation is affected by increasing the oxygen intake, a process which stimulates metabolic action at a time that the body is actually functioning to conserve it.

Still another object of the invention is to cause mechanical working of smaller blood vessels, particularly the capillaries, so that the blood flow and therefore local basic metabolism, will be improved. This result is particularly important as a means of combating the reduction in the "tone" of the blood vessels, the deteriorating condition which is progressive with age in the adult human being, and which is due to the progressive reduction of the diameter of blood vessels and the thickening of the walls of the blood vessels that occurs with increasing age.

Further objects and advantages of the invention may be brought out in the following part of the specification wherein small details have been described for the competence of disclosure, without intending to limit the scope of the invention which is set forth in the appended claims.

Referring to the accompanying drawings, which are for illustrative purposes only:

FIG. 1 is a side elevational view, partially in cross section, of an apparatus according to the present invention;

FIG. 2 is a cross sectional view taken as indicated by the line 2—2 in FIG. 1;

FIG. 3 is a fragmentary cross sectional view of another embodiment of the invention;

FIG. 4 is a view of an embodiment of the invention, similar to that in FIG. 3, and having another type of actuating means;

FIG. 5 is a side elevational view of still another embodiment of the invention, having a plurality of pressure varying means;

FIG. 6 is a cross sectional view taken as indicated by the line 6—6 in FIG. 5;

FIG. 7 is a cross sectional view of a liquid containing chamber, similar to that in FIG. 1, and illustrating pressure waves of different magnitude induced around the periphery of the chamber;

FIG. 8 is a fragmentary cross sectional view taken as indicated by the line 8—8 in FIG. 7;

FIG. 9 is a graphical representation of pressures effected by the invention on a body, the pressures being comprised of a low constant negative and a high pulsed negative;

FIG. 10 is a graphical illustration of typical pressure variations for use with a 60-beat per minute heart pulse;

FIG. 11 is a graphical illustration of the use of three variations in pressure—a constant negative pressure; a deep, sharp, short dwell negative pressure; and a slow, medium negative pressure; and

FIG. 12 is a graphical representation of the use of a constant negative pressure interspersed with high, short, positive pressures and relatively slow and easy negative pressures.

Referring now to the drawings, in FIG. 1 there is shown an open-ended, elongated chamber **10**, having an elliptical cross section, as shown in FIG. 2, and being adapted to receive in its open end **11** the substantial portion of a human leg **12**. A seal is formed so as to close the chamber by means of expandable tube **13** attached to the chamber, and which is shown to be inflated so as to be in snug, sealing contast with the periphery of the leg. The tube **13** may be inflated by conventional means through tube **17**.

The chamber **10** is shown to be filled with a liquid **18**, such as water, the latter being supplied to the chamber after the leg is sealed therein through inlet **19**. The chamber must be completely filled with the liquid and as it is filled, the manometer **20** may serve as the vent means to permit all the air in the chamber to be discharged.

In order that the temperature of the liquid **18** may be maintained at the desired constant temperature, a heat exchanger **24** is connected to the chamber by means of a pipe **25** to which is also connected a circulating pump **26**. The pump is run as necessary to circulate the liquid through the heat exchanger. Extending upwardly from the chamber and connected thereto is a piezoelectric gauge which measures very rapid and small pressure changes in the liquid.

At the left end of the chamber in the drawing, is a cylinder **31** having a reciprocating piston **32** therein. One end of the cylinder is connected to the chamber by a tube **33** so that movement of the piston **32** will change the pressure within the chamber. Through the other end of the cylinder extends a piston rod **34**, connected to the piston **32**. The rod **34** has its outer end **38** rotatably secured to a connecting rod **39** having its one end **40** rotatably secured to an eccentric pin **41** secured on a wheel **44** and driven by motor **45**. Thus, the operation of the motor rotates pin **41** so as to reciprocate rods **39** and **34** and the piston **32**. The piston may be adjusted with a starting position either with a zero gauge pressure or a constant positive or negative pressure, and any movement of the piston will then either increase the pressure in chamber **10** or decrease it.

In FIG. 3, there is a chamber **10***a*, similar to chamber **10**, having at its left end in the drawing and sealingly engaged therewith, a flexible diaphragm **46**. Attached to the diaphragm is a spring **47**. At the outer end of the spring is attached a rod **34***a* supported in a bearing **50** and having its outer end **38** secured to be reciprocated by connecting rod **39**, driven by the motor **45**.

Here, if the spring **47** is a tension spring, it can be set to provide a permanent suction on the chamber **10***a*, and which in FIG. 3 can be increased by rotation of the wheel **44** 180 degrees and then again decreased to the low suction. Similarly, if a compression spring is used, a permanent pressure can be exerted in the tank and this can be either increased or decreased, depending upon starting position. If the spring **47** in FIG. 3 were a compression spring, the highest pressure in tank **10***a* would be exerted in the position shown in FIG. 3.

In FIG. 4, the chamber and spring are the same as in FIG. 3. Here, however, the outer end **38** of the rod **34***a* is secured for rotation on a pin **51** which extends into and is loosely fitted in a circular groove **52** in wheel **53** which is adapted to be rotated by the motor **45**. Since groove **52** is eccentric relative to the rotation of wheel **53**, as the latter is rotated the pin **51** will be moved by the rotating groove **52** so that the rod **34***a* and the spring **47** will be reciprocated, the pin having a constant vertical position.

In FIGS. 5 and 6, another embodiment of the invention is illustrated. Here, a chamber **57** is provided to receive both legs and a portion of the body **58** up to approximately the waist line about which the sealed tube **59** is snugly fitted, the seal being secured in the opening **60** of the chamber.

The chamber has a raised, central upper portion terminating in an air bleed-off tube **64**. Thus, as the chamber is filled with a liquid **61** through inlet **62**, the liquid being under pressure, all of the air will be forced out of the highest point of the chamber through the tube **64**.

In FIG 5, three separate pressure variation means are

provided. On the left end of the tube is a flexible diaphragm **46**, as illustrated in FIGS. 3 and 4. In this arrangement, the end of the connecting rod **38** is on a pin **65** extending into a groove **66** which provides a cam following path for the cam **67**, formed by cutting the groove in a wheel **70** which is rotated by the motor **45**. In the position shown in FIG. 5, any rotation of the wheel **70** will cause the diaphragm to move to the left and thus exert a suction on the chamber so as to reduce the pressure therein. As can be seen from the shape of the cam **67**, the movement of the diaphragm will be slight but relatively rapid.

Extending from the lower end of the chamber **57** adjacent the diaphragm is a cylinder **71** having therein an adjustably-fixed piston **72**. The piston is fixed in position for any particular operation, either to exert a constant negative or a constant positive pressure within the chamber and on the body being treated. The adjustment of the piston may be made, for example, by the rotational adjustment of a rod **73** threadedly engaged in the cylinder and connected to the piston.

Adjacent the open end of the chamber **57** is a second cylinder **76** having therein a reciprocating piston **77**. The piston **77** is held in a normally up position by means of a spring **78**, as shown, if it is to exert an increasing negative pressure, or if it is to exert a positive pressure, it is held downwardly by a spring. Here, a piston rod **79** forms a core of a solenoid coil **80**.

The solenoid **80** is actuated by an electromechanical means comprised of a motor **81** and its shaft **82**, which drives a rotary switch **83** having a plurality of contacts **84**. Also secured to the shaft **82** is a continuous electrical contact roller **87** which forms part of the solenoid circuit **88**, connected to a solenoid operating power supply. Thus, as the motor drives the rotary switch, continuous contact is made by lead **89** with the roller **87**, the latter being connected to contacts **84**, and the solenoid is operated as the circuit is closed when any one of the contacts **84** moves into alignment with lead **90**.

The operation of the solenoid causes the piston **77** to move downwardly and to exert a sharp, negative pressure within the chamber **65** and on the part of the body being treated. As can be seen from the switch **83**, the period of the negative pressure increase is very short but it occurs at a high frequency.

In FIGS. 9–12, the effects of the operation of the pistons or diaphragms in the foregoing embodiments are shown graphically. For example, if the piston **32** in FIG. 1 or the diaphragms **46** in FIGS. 3 and 4 had a presetting of a low constant negative pressure, this pressure would be indicated in FIG. 9 in the low constant negative pressure line. Then, when the piston or diaphragm was moved outwardly away from the chamber at a rapid rate for a fraction of a second, once a second, a high negative pressure, as indicated in FIG. 9, would be produced for a very short period of time, the maximum being reached when the piston or diaphragm had been moved its greatest amount. It should be noted that the slight movement of a very small piston can produce a very large variation in pressure when the chamber is susbtantially entirely filled with liquid.

As previously described, the structure in FIG. 5 may vary the pressure in three different ways at three different amounts for three different periods. One method of operation of this structure is shown in FIG. 10 where the diaphragm **46** is indicated to be at a normal zero pressure, as indicated by the line A, and when actuated creates the rather gradual dip having its nadir at B. A constant negative pressure can be applied by the piston **72** and a slow drop in pressure, as indicated by the line D, can be applied by the piston **77**, the length of the low pressure being determined by the relatively slow rate of the movement of the rotary switch **83** in FIG. 5.

The pressure variations in the graph shown in FIG. 11 can also be accomplished by the structure shown in FIG. 5 where a constant pressure, indicated by the line E, can be applied by the piston **72**. Then, by having a rapid switch **83**, with a fast pulling solenoid coil **80**, the high negative pressure G can be applied at frequent intervals during a second. The third pressure variation can be applied by the actuation of diaphragm **46**, such actuation as indicated by the shape of the graph being relatively slow.

The pressure variation shown in the graph in FIG. 12 could also be accomplished by the structure shown in FIG. 5 with some modification. Here, the line E′ represents the negative pressure applied by the piston **72**; the line F′ indicates the negative pressure applied by the operation of the diaphragm **46**; and the high positive pressure could be applied by the piston **77** with a constantly energized solenoid **80** having the spring **78** to push the piston up and increase the pressure when the solenoid was deenergized. Another way of accomplishing the same result would be by having a constant negative pressure E′ applied by the spring **47** on the diaphragm **46** and by varying operation of the diaphragm by the actuation of rod **34***a* so as to create the pressure indicated by line F′, and then operating the piston **72** at a very rapid rate for a short period to produce the pressure indicated by the line G′. In such an installation, the piston **77** would not be necessary.

In FIGS. 7 and 8, another embodiment of the invention is illustrated. Here, the chamber **93** is cylindrical and is shown only in cross section. Mounted on the chamber and generally evenly spaced with respect to its circumference are three solenoids **94**. Inwardly of each solenoid is a diaphragm **95**, as best seen in FIG. 8. Each solenoid has a core **96** adapted to be moved radially inwardly by a spring **99** when the solenoid is deenergized.

In operation, the solenoids are successively operated so as to induce pressure waves of various amounts, as indicated in FIG. 7, by **100**, **101** and **102**. Such a series of pressure waves at the various points and at controlled intervals creates a focusing action at a depth within the body to affect the particular zone profoundly.

It will be appreciated that while the drawings show the treatment of a leg and lower body, other parts of the body can be so treated. For instance, an arm can be so treated. In fact, by providing a suitable breathing mask and ear plugs to avoid damage to the ear drums, the entire body can be treated. In particular, the advantage of stimulating blood flow in the cranial blood vessels is obvious in cases where reduction in flow can cause impairment of mental functions and in the case of elderly patients, can produce a condition of senility.

It will be further appreciated that the operation of the device in a room at atmospheric pressure will limit the reduction of pressure to a minimum of one atmosphere, whereas if the device and the patient are totally enclosed in an air-filled pressurized chamber where the pressure is maintained at, for instance, from one pound per square inch to fifty pounds per square inch in excess of atmospheric pressure, then the limit of reduction of pressure applied by the device to the patent can be increased to a maximum represented by the sum of the current atmospheric pressure and the over-pressure of the chamber.

Conversely, it is obvious that if the pressure in such chamber is reduced below that of the atmosphere, e.g. to only seven pounds per square inch, then the limit of extra negative pressure which the machine can apply to the part of the body being treated is the pressure in the said chamber.

Again, it will be appreciated that the control of pressure variations of the device can be associated with the heat beat of the patient by the use of a sensing device near the heart which can control the application of pressure variation to the part of the body being treated. Such a sensing device could be a small microphone pick-up which would operate the controls with a suitable delay,

measured in milliseconds, to produce a negative pressure at the part of the body being treated, such negative pressure coinciding with or slightly anticipating or lagging the arrival of the positive pressure pulse from the heart in the arteries at that location.

I claim:

1. In a variable, liquid pressure device for affecting the metabolism of parts of the body of human beings or animals, a chamber for containing a liquid under pressure; said chamber having an opening adapted to receive a part of a body; a seal being formable at said opening in contact with said body to close said chamber; means to fill said chamber with liquid after said opening is closed; and means to vary the pressure of all the liquid in the chamber.

2. In a variable, liquid pressure device for affecting the metabolism of parts of the body of human beings or animals, a chamber for containing a liquid under pressure; said chamber having an opening adapted to receive a part of a body; a seal being formable at said opening in contact with said body to close said chamber; means to fill said chamber with liquid after said opening is closed; and means to vary the pressure of all the liquid in the chamber and to vary the pressure of liquids in the part of the body.

3. In a variable, liquid pressure device for affecting the metabolism of parts of the body of human beings or animals, a chamber for containing a liquid under pressure; said chamber having an opening adapted to receive a part of a body; a seal being formable at said opening in contact with said body to close said chamber; means to fill said chamber with liquid after said opening is closed; means to vary the pressure of all the liquid in the chamber; and means in communication with said chamber to maintain the liquid therein at a predetermined temperature.

4. In a variable, liquid pressure device for affecting the metabolism of parts of the body of human beings or animals, a chamber for containing a liquid under pressure; said chamber having an opening adapted to receive a part of a body; a seal being formable at said opening in contact with said body to close said chamber; means to fill said chamber with liquid after said opening is closed; and means to provide variable pressure changes of all the liquid in said chamber and at various rates.

5. In a variable, liquid pressure device for affecting the metabolism of parts of the body of human beings or animals, a chamber for containing a liquid under pressure; said chamber having an opening adapted to receive a part of a body; a seal being formable at said opening in contact with said body to close said chamber; means to fill said chamber with liquid after said opening is closed; and means to vary the pressure of a constant volume of liquid in communication with said chamber.

6. In a variable, liquid pressure device for affecting the metabolism of parts of the body of human beings or animals, a chamber for containing a liquid under pressure; said chamber having an opening adapted to receive a part of a body; a seal being formable at said opening in contact with said body to close said chamber; means to fill said chamber with liquid after said opening is closed, said seal including a tube defining said opening, said tube being expandable to be snugly fitted around said body part; and means to vary the pressure of all the liquid in the chamber.

7. In a variable, liquid pressure device for affecting the metabolism of parts of the body of human beings or animals, a chamber for containing a liquid under pressure; said chamber having an opening adapted to receive a part of a body; a seal being formable at said opening in contact with said body to close said chamber; means to fill said chamber with liquid after said opening is closed; means to vary the pressure of all the liquid in the chamber, said means including a cylinder in communication with said chamber; a piston in said chamber; and power means to reciprocate said piston in said cylinder.

8. In a variable, liquid pressure device for affecting the metabolism of parts of the body of human beings or animals, a chamber for containing a liquid under pressure; said chamber having an opening adapted to receive a part of a body; a seal being formable at said opening in contact with said body to close said chamber; means to fill said chamber with liquid after said opening is closed; and means to vary the pressure of all the liquid in the chamber, said means including a flexible member forming a portion of a wall of said chamber and means to move said member toward and away from said chamber.

9. In a variable, liquid pressure device for affecting the metabolism of parts of the body of human beings or animals, a chamber for containing a liquid under pressure; said chamber having an opening adapted to receive a part of a body; a seal being formable at said opening in contact with said body to close said chamber; means to fill said chamber with liquid after said opening is closed; first means to vary the pressure of all the liquid in the chamber a predetermined amount at a predetermined rate; and second means to vary the pressure of all the liquid in the chamber a greater predetermined amount at a greater predetermined rate than said first means.

10. The invention according to claim 9 including means to apply a constant negative pressure on all the liquid in the chamber.

11. In a variable, liquid pressure device for affecting the metabolism of parts of the body of human beings or animals, a chamber for containing a liquid under pressure; said chamber having an opening adapted to receive a part of a body; a seal being formable at said opening in contact with said body to close said chamber; means to fill said chamber with liquid after said opening is closed; and means to vary the pressure of all the liquid in the chamber, said means including a plurality of flexible members, each forming a portion of a wall of said chamber, and operating means to move said members relative to said chamber in a cycle of increasing amounts of movement at successive intervals.

12. A method of affecting the metabolism of parts of the body of human beings or animals comprising: enclosing a part of a body to be treated in a chamber; sealing said part in said chamber; filling said sealed chamber with liquid; and varying the pressure of all of said liquid a predetermined amount at a predetermined rate.

13. A method of affecting the metabolism of parts of the body of human beings or animals comprising: enclosing a part of a body to be treated in a chamber; sealing said part in said chamber; filling said sealed chamber with liquid; and applying predetermined positive and negative pressures to all of said liquid at predetermined rates.

14. A method of affecting the metabolism of parts of the body of human beings or animals comprising: enclosing a part of a body to be treated in a chamber; sealing said part in said chamber; filling said sealed chamber with liquid; and producing small amplitude shock waves in all of the liquid at predetermined rates.

15. A method of affecting the metabolism of parts of the body of human beings or animals comprising: enclosing a part of a body to be treated in a chamber; sealing said part in said chamber; filling said sealed chamber with liquid; applying a constant pressure in all of the liquid; and inducing rhythmic pulsations to create different pressures in all of the liquid.

16. A method of affecting the metabolism of parts of the body of human beings or animals comprising: enclosing a part of a body to be treated in a chamber; sealing said part in said chamber; filling said sealed chamber with liquid; varying the pressure of all of said liquid a predetermined amount at a predetermined rate; and superimposing on said rate sharp staccato fluctuations in pressure.

17. A method of affecting the metabolism of parts of

the body of human beings or animals comprising: enclosing a part of a body to be treated in a chamber; sealing said part in said chamber; filling said sealed chamber with liquid; and maintaining vibratory pulsations in all of the liquid at rates between 100 and more than 20,000 vibrations per second.

18. A method of affecting the metabolism of parts of the body of human beings or animals comprising: enclosing a part of a body to be treated in a chamber; sealing said part in said chamber; filling said sealed chamber with liquid; maintaining the liquid at a substantially constant temperature; and varying the pressure of all of said liquid a predetermined amount at a predetermined rate.

19. A method of affecting the metabolism of parts of the body of human beings or animals comprising: enclosing a part of a body to be treated in a chamber; sealing said part in said chamber; filling said sealed chamber with liquid; varying the pressure of all of said liquid a predetermined amount at a predetermined rate; and increasing the molecular movement of tissues in said part of the body.

20. A method of affecting the metabolism of parts of the body of human beings or animals comprising: enclosing a part of a body to be treated in a chamber; sealing said part in said chamber; filling said sealed chamber with liquid; and generating pressure waves at a plurality of points in said liquid so that a deep-seated focus of wave energy results.

21. A method of affecting the metabolism of parts of the body of human beings or animals comprising: enclosing a part of a body to be treated in a chamber; sealing

said part in said chamber; filling said sealed chamber with liquid; generating pressure waves at a plurality of points in said liquid so that a deep-seated focus of wave energy results; and cycling said pressure waves by progressive stimulation at microsecond intervals to cause said focus to move in any desired manner.

22. A method of affecting the metabolism of parts of the body of human beings or animals comprising: enclosing a part of a body to be treated in a chamber; sealing said part in said chamber; filling said sealed chamber with liquid; and varying the pressure of all of said liquid a predetermined amount at a rate at a multiple of the heart beat of the body being treated.

23. A method of affecting the metabolism of parts of the body of human beings or animals comprising: enclosing the entire body in a pressurized air-filled chamber; enclosing a part of said body to be treated in a smaller chamber within said air-filled chamber; sealing said part in said smaller chamber; filling said smaller chamber with liquid; and varying the pressure of all of said liquid a predetermined amount at a predetermined rate.

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